Annual Water Quality Report

BLACK BUTTE LAKE

Water Year 2002

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Black Butte Lake

I. Purpose

This report is part of an environmental monitoring program that began at Black Butte Lake in September 1973. The monitoring program was implemented to determine water quality in the lake for both recreation and environmental health. This report was written to satisfy Department of Army Engineering Regulation 1110-2-8154, “Water Quality and Environmental Management for Corps Civil Works Projects”.

II. Brief Description of Black Butte Lake

Black Butte Lake was formed in 1963 upon the completion of Black Butte Dam. Black Butte Lake is located west of Orland, California on Stony Creek. It is an inviting and accessible recreation area on the west side of the Sacramento Valley. When full the lake has a surface area of 4,460 acres, is seven miles long, and has a shoreline of 40 miles. The dam provides flood damage protection for local towns and agricultural lands as well as recreation for the general public.

Generally there are two sample events each year, spring (April) and late summer (August). Since the start of the monitoring program, a water quality report has been produced yearly to list results and address any concerns of the previous water year.

Historically Black Butte Lake has a depth of < 100 ft, and is considered a hyper-eutrophic (very nutrient rich) lake when characterized by its clarity. One of the common characteristics of a hyper-eutrophic lake such as Black Butte Lake is that during warm late summer months the lower depths are extremely low in dissolved oxygen (DO). Additionally Black Butte Lake is warm (>20°C) in the late summer. Due to both the low DO concentrations and high temperatures, warmwater fish species are well suited to survive in the lake. Warmwater fish species include bass, carp, perch, bluegill, crappie, and catfish. Another characteristic of eutrophic (nutrient rich) lakes is their low water clarity due to algal blooms. A further characteristic of shallow lakes are sediments suspended by wind action which is another impediment to water clarity. Water clarity is often measured in terms of Secchi Disc depth or SD (Glossary, Appendix A). Historically the water clarity in Black Butte Lake has been low with ~37 % of the samples not meeting the recreational goal of 4 feet or greater (Figure 1.). In 2001 the Spring SD measure was below 4 ft (SD = 3 ft) and the late summer sample was clearer (SD = 6.58).

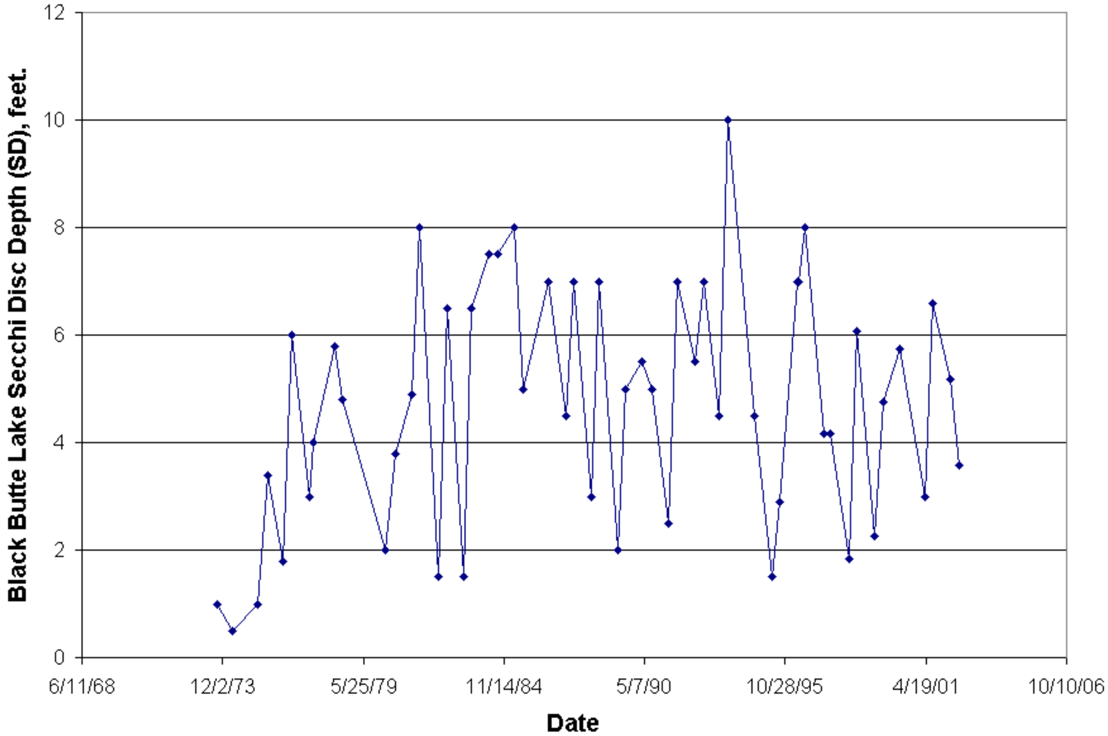

Figure 1. Historical Secchi Depth Values at Black Butte Lake (2002 values included).

The 2001 Water Quality Report listed only mercury as a contaminant of concern in Black Butte Lake. Due to high mercury concentrations in water found in 1999 and 2000 water samples, annual fish sampling was initiated in October 2000. While the mercury Maximum Contaminant Level (MCL = 2 ppb Hg) in water for human health was not exceeded, composite fish samples for mercury in 2000 and 2001 were 0.37 ppm and 0.58 ppm. Since both of these concentrations were above the U.S. Environmental Protection Agency's action level to continue fish tissue monitoring (0.3 ppm) fish monitoring was continued in 2002. The highest level for mercury in water (0.2 ppb) was found at the lake bottom in the Spring 2000 sample. In spring 2001 the concentration of mercury at the bottom was much lower (0.0049 ppb). .

III. Sample Summaries for This Year

Introduction

The following general summaries are split into their respective sample types. Each type of sample summary includes a discussion of both the Spring (April) and late Summer (August) samples to better examine trends within the current year. The types of parameters monitored this year include: Secchi Disc depths, water column profiles (temperature, DO and pH), phytoplankton characterization, metals concentrations, MTBE concentrations, Inorganic characterization (alkalinity, phosphorous, nitrogen, etc..), and fish mercury concentrations. For a more detailed explanation of the importance of each type of sample, please see Appendix A.

SECCHI DEPTH

The Secchi Disc depth found during the spring and late summer sampling in 2002 were similar to depths observed in previous years. Traditionally the lake had a higher clarity in the spring than in the late summer (Appendix B). In the spring the water clarity was higher and had a SD of 5.17 feet. The late summer SD of 3.58 feet was below the recreational goal of 4 feet.

TEMPERATURE VALUES

The temperature profiles for Black Butte Lake are indicative of a well-mixed shallow lake. A minimal amount of stratification can be seen in the spring, but disappears by the warm temperatures of late summer. While the depth of the lake at the spring and late summer sampling events was similar (spring depth = 85.3 feet, late summer depth= 78.7 feet), the average temperatures were very different (spring average temp. = 11.95 ºC , late summer average temp.= 24.34 ºC). The lake's temperature varies due to not having a deep-water area to buffer the warm summer air temperatures. Due to the warmth of the water, Black Butte Lake wouldn't reliably support coldwater fish species. For detailed temperature information obtained during the sampling events, please see Appendix B.

DISSOLVED OXYGEN

Dissolved oxygen (DO) concentrations differ greatly from spring to late summer. In the spring, DO concentrations are super saturated (12.2 mg/l DO) near the surface and high at the bottom (9.7 mg/L) of the lake. DO concentrations near the surface are above saturation (10.34 mg/l at 13.8ºC) due to phytoplankton photosynthesis. DO concentrations in the late summer are much lower and have a steady gradient from the surface (DO = 5.2 mg/l) to the bottom of the lake (DO =0.3 mg/l). The low DO values at the bottom of the lake are associated the decomposition of waste materials at accelerated rates due to the warm temperatures. Fish species that require greater than 5 mg/l DO and cooler water temperatures (< 20ºC) would be unlikely to survive in Black Butte Lake. For detailed results obtained during the sampling events, please see Appendix B.

PH LEVELS.

In the spring sample event, pH values in the lake were slightly basic (pH = ~7.4) throughout the water column. The pH values in the late summer profile varied widely. The pH generally was more basic towards the surface and middle waters (max pH = 8.8) and lowest at the bottom (pH = 7.8). The lower pH value at the bottom of the lake increases the likelihood that higher soluble metal concentrations will be in lake bottom samples. For detailed results obtained during the sampling events, please see Appendix B.

PHYTOPLANKTON

In the spring sample, the algal biomass in the lake was very low (Biomass = 94.7 µg/L) with green algae being the most dominant species. In late summer the phytoplankton population was much higher (Biomass = 1498.8 µg/L) with the largest concentration being diatoms, followed by blue green algae. For detailed results obtained during the sampling events, please see Appendix C.

METALS

All of the dissolved heavy metals were less than the maximum contaminant level (MCL) and the freshwater fishery criteria during either the spring or summer except for dissolved manganese. Manganese exceeded what is known as a "secondary" MCL. It is termed a secondary MCL because at the level established (50 ppb) it is not a health concern, but a water hardness concern. Every late summer sampling period, a higher concentration of dissolved manganese is found at the bottom of the lake. While there isn't a set fish criteria limit for manganese, the last two summers water at the bottom of Black Butte Lake has exceeded the secondary MCL for manganese (50 ppb). The concentration of dissolved manganese in summer lake bottom samples for 2001 and 2002 were 320 ppb and 420 ppb respectively. For detailed results obtained during the sampling events, please see Appendix D.

MTBE

All results were below the reporting limit of 2 ppb with one exception, 2 ppb in the spring lake sample. For detailed results obtained during the sampling events, please see Appendix F.

INORGANIC ANALYSIS

The spring sample analysis had several interesting results, but they weren't much different from the 2001 report. The 2002 alkalinity in the spring (100 mg/l $CaCO_3$) was tied for the highest spring value of all the lakes monitored by the USACE. In spring 2001, alkalinity in Black Butte Lake was also high (110 mg/L $CaCO_3$). The chloride concentration in the spring (Chloride = 13 ppm) was high when compared to other monitored lakes, but not much different from last year (Chloride = 10 ppm). Total Solids concentrations were the highest of all the lakes monitored this year (Lake TS = 170 mg/L), but were nearly identical to spring 2001 values.

Late summer 2002 sampling event results were similar to values from late summer 2001. The alkalinity was the highest value of all the lakes monitored (Lake Alkalinity =

140 mg/L CaCO3, Inlet Alkalinity= 150 mg/L CaCO3), which was also true in late summer 2001. Chloride concentrations were again high (Lake and Inlet Chloride =16 ppm) when compared to other lakes, but not significantly different from last year. Total solids values in the lake (Lake and Inlet TS = 200 mg/L) were the highest when compared to all of the monitored lakes in summer 2002, but were only 10 mg/L greater than last year. For detailed results obtained during the sampling events, please see Appendix E.

FISH SAMPLE ANALYSIS

Fish tissue analysis for total mercury was performed on a composite sample composed of tissue from three small mouth bass collected in June 2002. The composite sample had a resulting total mercury concentration of 0.26 ppm. This is well below the U.S. F.D.A. criteria for a fish advisory (1 ppm). The results were encouraging since small mouthed bass eat other fish and therefore are expected to bio-accumulate mercury, sometimes to high levels. The 2002 composite sample had a lower mercury concentration than both the 2000 (0.37 ppm) and 2001 (0.58 ppm) fish composite samples. Although the 2002 fish composite sample was below the California OEHHA screening level (0.3 ppm) to cease monitoring, monitoring of fish tissue will continue due to higher concentrations in previous years. For detailed results obtained during the sampling events, please see Appendix G.

IV. Conclusions

Black Butte Lake is a relatively shallow eutrophic lake that can support warmwater fish species. Coldwater fish species that require temperatures below 20°C and dissolved oxygen concentrations greater than 5 mg/L would have difficulty surviving summer conditions at Black Butte Lake. Due to a near neutral pH near the bottom of the lake and increased bacterial activities during the warm summer months, some metals within lake sediments are being converted into soluble forms.

Results from testing indicated no contaminants of concern in Black Butte Lake during the spring and summer sampling events. Contaminants in water and mercury within fish tissue will be monitored again in 2003.

V. References

North American Lake Management Society (1990). *Lake and Reservoir Restoration Guidance Manual*, EPA 440/4-90-006, U.S. Environmental Protection Agency, Washington, DC.

Novotny, V., and H. Olem (1994). *Water Quality: Prevention, Identification, and Management of Diffuse Pollution*, Van Nostrand Reinhold, New York, New York.

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Welch, E.B. (1992) *Ecological Effects of Wastewater: Applied limnology and pollutant effects,* Chapman and Hall, Cambridge University Press, Great Britain.

Wetzel, R.G. (1975). *Limnology*, W.B. Saunders Company, Philadelphia, PA.

VI. Appendices

Appendix A: Glossary of Sample Types

Glossary of Sample Types

This glossary of sample types is intended to provide a general background and indicate the importance of each sample in determining water quality. These are meant to be brief and basic. If a further explanation is desired please refer to the list of references provided in this report.

Secchi Depth

One of the oldest and easiest methods to determine lake clarity is the Secchi depth (SD). The Secchi depth is determined by dropping a Secchi disc into a water body and determining the depth that it is last visible from the surface of the water. Secchi discs are generally white and 20 cm in diameter. Secchi depth values are most impacted by the light intensity at the time of sampling and the scattering of light by solid particulates within the water column. Algal growth (phytoplankton) and sediment re-suspension are often major constituents of solid particulates within the water column. Secchi depth values can be used to estimate the Trophic state or the nutrient levels within the lake. The more nutrients are available, the larger likelihood of algal blooms that limit water clarity. Due to recreational concerns for safety, the goal for Secchi depth values is four feet or greater.

Temperature Profiles and Data Points

The temperature profile of a lake provides information how a lake is operating and the potential for aquatic biota to live within the lake. The temperature profile is a direct indicator if a lake is stratified. Stratification in lakes is created generally by temperature affecting the density of water molecules. Stratification is usually indicated by a region of similar temperature nearer the surface of the water (epilimnion), then a region of temperature transition (metalimnion), to another layer of nearly constant temperature at the bottom of the lake (hypolimnion). Each layer in a stratified lake is important, but the existence of a hypolimnion can drastically impact how well a lake can handle warmer temperatures such as those found in northern California during the summer. The hypolimnion acts as a buffer against large temperature shifts. The nature of dam operation is that water is discharged near the bottom, releasing the hypolimnion, and eliminating stratification. This operation limits the ability of reservoirs to regulate their temperature during the summer months. Stratification isn't always desirable. When a lake isn't stratified and is instead well mixed, the required nutrients near the bottom of the lake become available to phytoplankton for growth. Temperatures within lakes also indicate which species of fish will survive within a lake. Coldwater species of fish require temperatures below 20 degrees C in order to spawn and survive. If a lake is often above 20 degrees C, then only warmwater fish species will survive.

Dissolved Oxygen (DO) Concentration Profiles

DO is required by organisms for respiration and for chemical reactions within lake waters. The recommended level for DO for most aquatic species survival is 5mg/L. In lakes, biota waste (detritus) falls to the bottom of the lake to be utilized by bacteria. The bacteria need oxygen and will deplete levels near the bottom of a lake, especially during warm temperature, high respiration conditions. For nutrient rich (eutrophic) lakes more organisms will grow, create wastes, and cause oxygen depleted regions at the lowest areas. Under these conditions only aquatic species that can survive low DO conditions in warm water near the surface will survive.

PH Profiles

The pH profiles of the lakes indicate the potential for certain chemical reactions to occur. In high pH (greater than pH = 7 or basic) aquatic systems, metal pollutants tend to form into insoluble compounds that fall onto the lake floor. In low pH (less than pH = 7 or acidic) systems or areas metal ions become soluble and available for uptake into aquatic organisms. Other compounds like ammonia that are introduced into a low pH aquatic environment will transform into soluble nitrate and be utilized by organisms.

Phytoplankton Analysis

Phytoplankton analysis indicates the health, nutrients, and biodiversity within a lake. Lakes that have few nutrients available (Oligotrophic) will generally have a much lower quantity of phytoplankton (high Secchi depth) but the number of phytoplankton species seen will be large. In a lake that is nutrient rich (eutrophic) there are generally large phytoplankton blooms (low Secchi depth), but they are made up of a couple of phytoplankton species. Certain species of phytoplankton are preferred food sources for zooplankton (small invertebrates). Generally species like diatoms and green algae can be consumed by the filter-feeding zooplankton, but species like bluegreen algae are low in nutrients and are difficult to consume. Some species like the dinoflagellates can grow horn like points to discourage potential predators. In nutrient rich waters where there is plenty of phosphorous, nitrogen can be limited for biological growth. While most species can't grow due to the lack of nitrogen, bluegreen algae (cyanobacteria) have the ability to utilize nitrogen from the atmosphere when required. This gives bluegreen algae the ability to dominate in many eutrophic lakes.

Soluble Metals Analysis

The soluble metals analysis indicates the exposure of humans and aquatic organisms to toxic metals. These metals often build up as they are consumed through the food chain. Water samples provide an indicator for additional problems. Soluble forms of metal ions are more prevalent in low pH (pH <7, or acidic) environments.

MTBE Analysis

MTBE (methyl tertiary-butyl ether) is a chemical additive to gasoline to improve combustion. Due to its high solubility, MTBE travels and blends into aquatic systems rapidly. While not found to be extremely hazardous at low levels, the offensive smell and taste is detectible by humans at extremely low concentrations. The effect of MTBE on humans and aquatic systems is still under investigation.

Inorganic Analysis

Alkalinity

Alkalinity is measured in terms of mg/L of calcium carbonate. It indicates a lakes ability to buffer incoming acidic pollution and situational changes.

Ammonia

Ammonia is a gas that is toxic to fish and is more visible at a higher pH. Ammonia is created through anthropogenic inputs, bacteria cell respiration, and the decomposition of dead cells. Due to being a gas, given time ammonia will volatilize from the water. At a lower pH, much of the ammonia is converted to ammonium (a nutrient for root bound plant life) and utilizes DO in the nitrification process.

Chloride

The chloride ion is an indicator of any salinity increases within a lake. Most fresh water aquatic species are sensitive to salinity changes.

Nitrate

Nitrate is the nitrogen product created through the nitrification of ammonium. Nitrate is a soluble form of the nutrient nitrogen and is utilized by phytoplankton.

Total Phosphorous

The total phosphorous provides a measure of both utilized and soluble phosphorous within water samples. Phosphorous is a required nutrient for plant growth and development.

Ortho Phosphorous

Ortho phosphorous is the soluble form of phosphorous that is utilized by free-floating aquatic plants (phytoplankton).

Kjeldahl N

Kjeldahl nitrogen or total Kjeldahl nitrogen (TKN) is a measure of the total concentration of nitrogen in a sample. This includes ammonia, ammonium, nitrite, nitrate, nitrogen gas, and nitrogen contained within organisms.

COD

Chemical Oxygen Demand (COD) is a measure of the total oxygen required to complete the chemical and biological demands of a sample.

Fish Tissue Analysis

Fish tissue is analyzed to examine potential exposure of humans to toxicants as well as the health of the aquatic food chain. In aquatic systems toxic contaminants can build up (or bioaccumulate) within animals at the top of the food chain. Contaminants (especially organic pollutants) are retained within the fat tissue of an organism, therefore in fish samples the lipid content is often measured.

Lake Code Designation

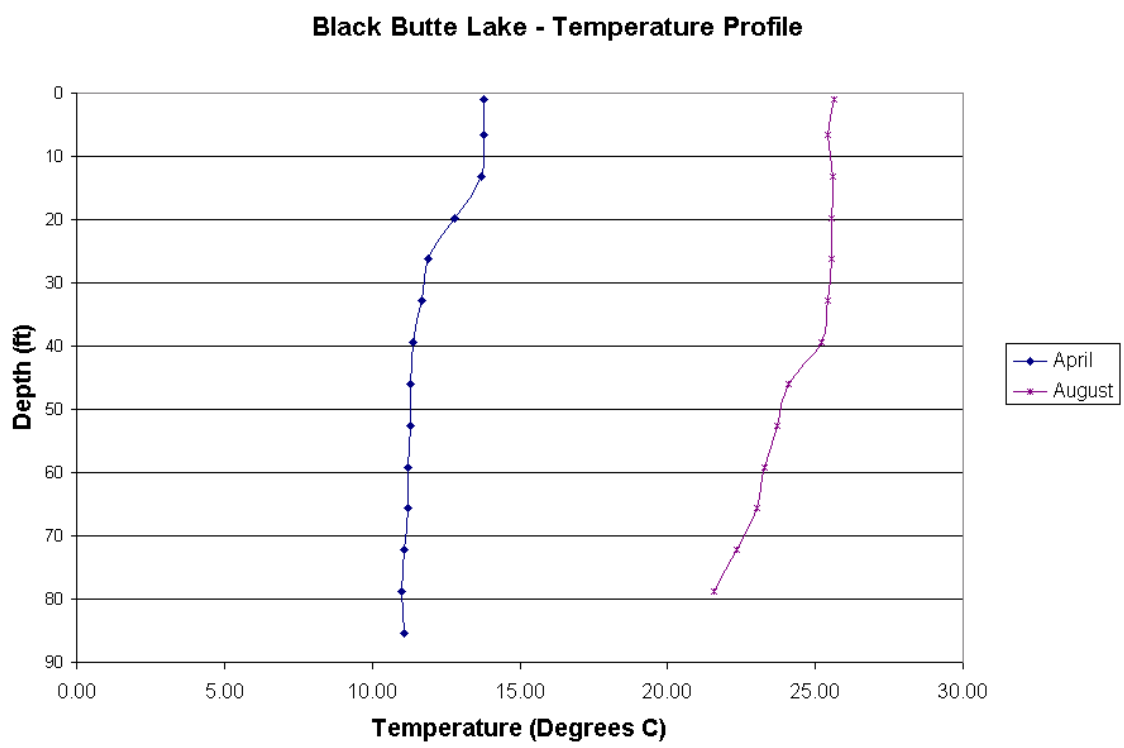
Laboratory Reports are provided in the previous sections.

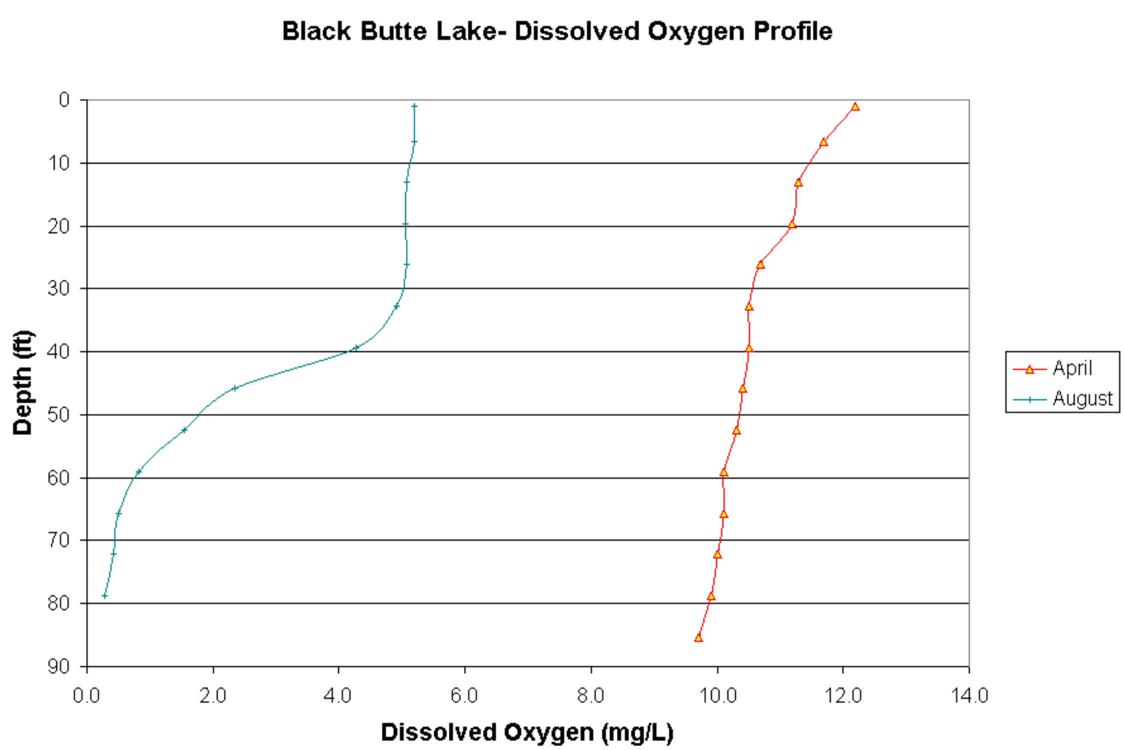
Sample ID is "XX-YY-ZZ" where

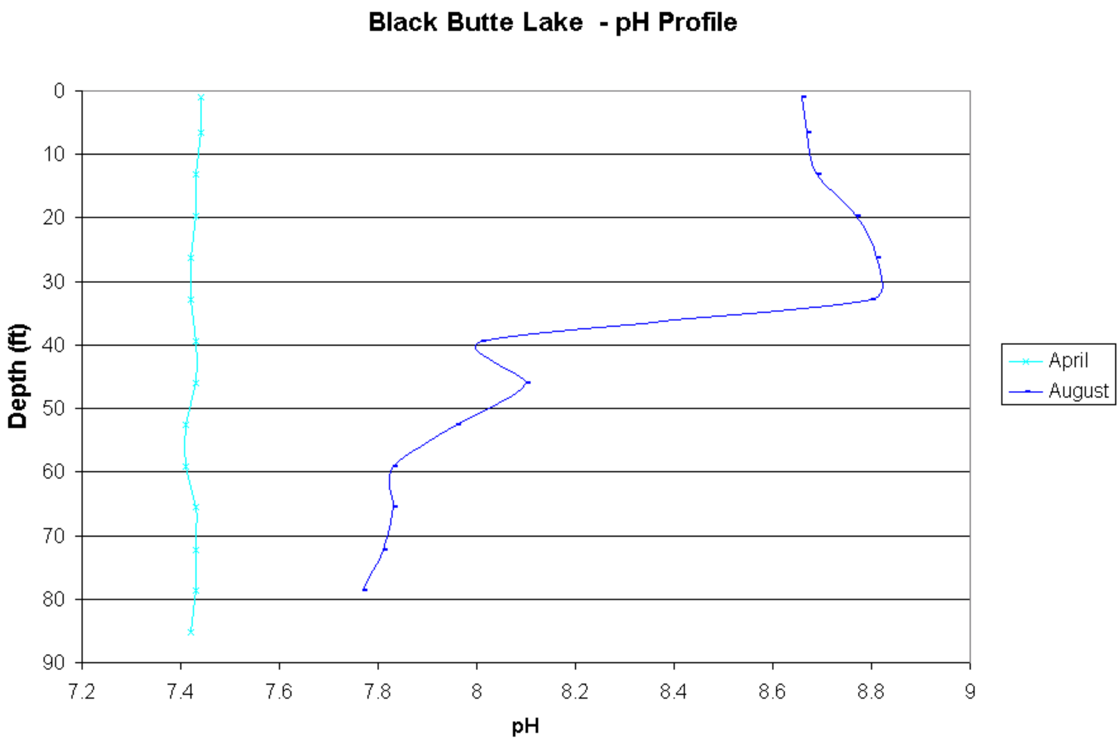
XX designation:	YY designation	ZZ designation
BB for Black Butte	SP for Spring	S for surface of Lake
EA for Eastman	SU for Summar	B for bottom of Lake
EN for Englebright		I-1 for inflow1
HE for Hensley		I-2 for inflow 2
IS for Isabella		O for outflow
KA for Kaweah		
ME for Mendocino		
MC for Martis Creek		
NH for New Hogan		
PF for Pine Flat		
SO for Sonoma		
SU for Success		

Example: BB-SU-S is for a water sample taken from Black Butte in the Summer on the Lake's Surface.

Appendix B: Profile Data and Charts (Secchi Disc, Temperature, DO, and pH)


Black Butte Lake - Temperature Profile
Depth (ft)
0
10
20
30
40
50
60
70
80
90
0.00
5.00
10.00
15.00
20.00
25.00
30.00
Temperature (Degrees C)
April
August


Black Butte Lake- Dissolved Oxygen Profile
Depth (ft)
0
10
20
30
40
50
60
70
80
90
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
Dissolved Oxygen (mg/L)
April
August

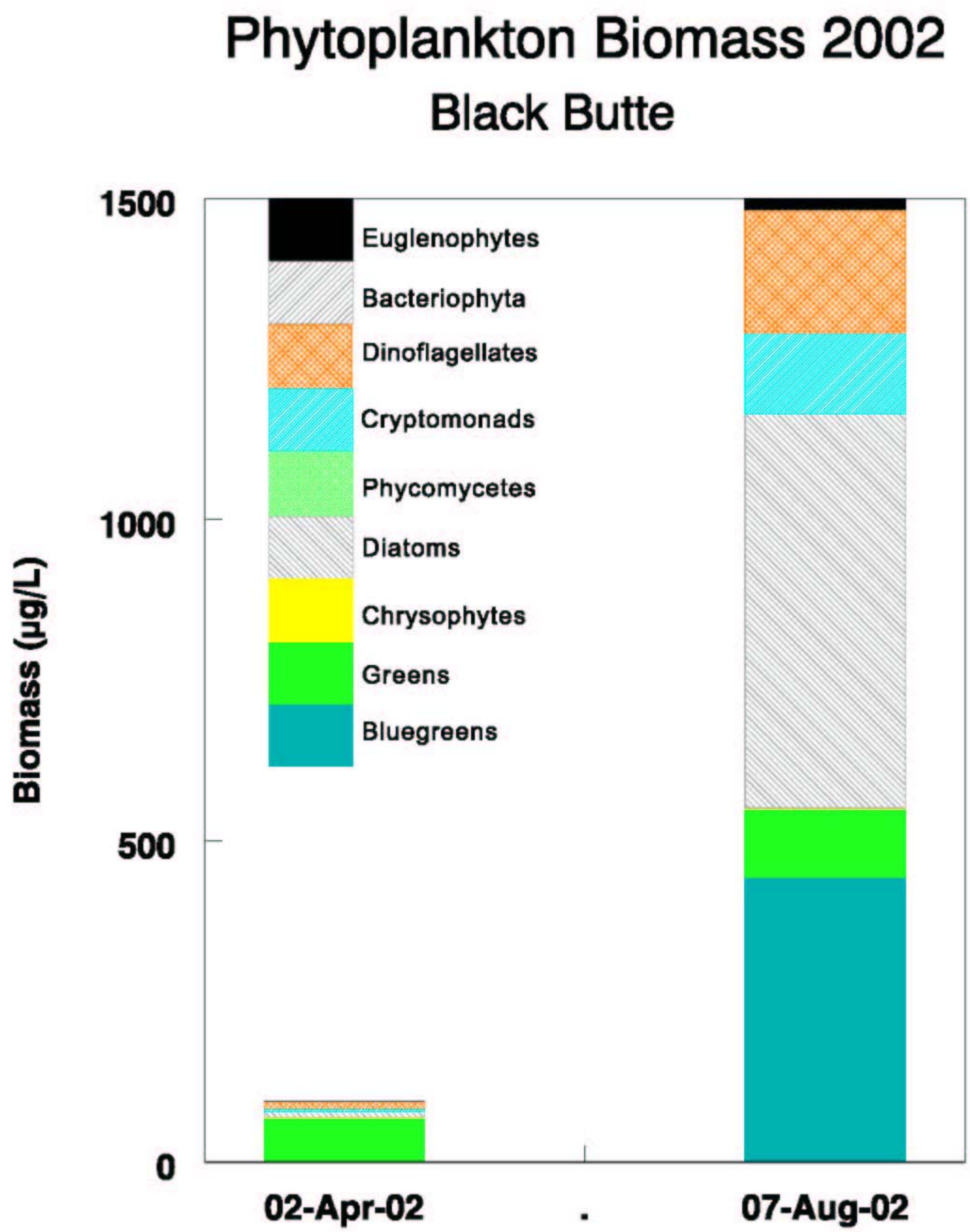


Black Butte Lake - pH Profile
Depth (ft)
0
10
20
30
40
50
60
70
80
90
7.2
7.4
7.6
7.8
8
8.2
8.4
8.6
8.8
9
pH
April
August

Black Butte					
Sample Location: Behind Dam				**Date:** 04/02/02	
Observers: Tim McLaughlin				**Time:** 10:45 am	
Lake Elevation: 461.8					
Weather Conditions:					
Wind Speed: 30		**Precipitation:** 0		**Temp (F):** 70	
SECCHI Depth: 5 feet and 2 inches					
Depth-M	**Depth-F**	**Temp-C**	**Cond**	**DOmg/L**	**pH**
24.8	85.3	11.10	266	9.7	7.42
24	78.7	11.00	266	9.9	7.43
22	72.2	11.10	266	10.0	7.43
20	65.6	11.20	264	10.1	7.43
18	59.1	11.20	265	10.1	7.41
16	52.5	11.30	265	10.3	7.41
14	45.9	11.30	265	10.4	7.43
12	39.4	11.40	265	10.5	7.43
10	32.8	11.70	265	10.5	7.42
8	26.2	11.90	265	10.7	7.42
6	19.7	12.80	266	11.2	7.43
4	13.1	13.70	267	11.3	7.43
2	6.6	13.80	267	11.7	7.44
0.03	1.0	13.80	267	12.2	7.44
NORTH FORK STONY CREEK (Inflow)					
Temp (F)	**pH**		**DOmg/L**	**EC**	**Flow rate (cfs**
71.2	7.51		-	-	10
SOUTH FORK STONY CREEK (Inflow)					
Temp (F)	**pH**		**DOmg/L**	**EC**	**Flow rate (cfs**
72.1	7.85		-	-	200
VISUAL OBSERVATIONS: Very windy with a muddy surface.					

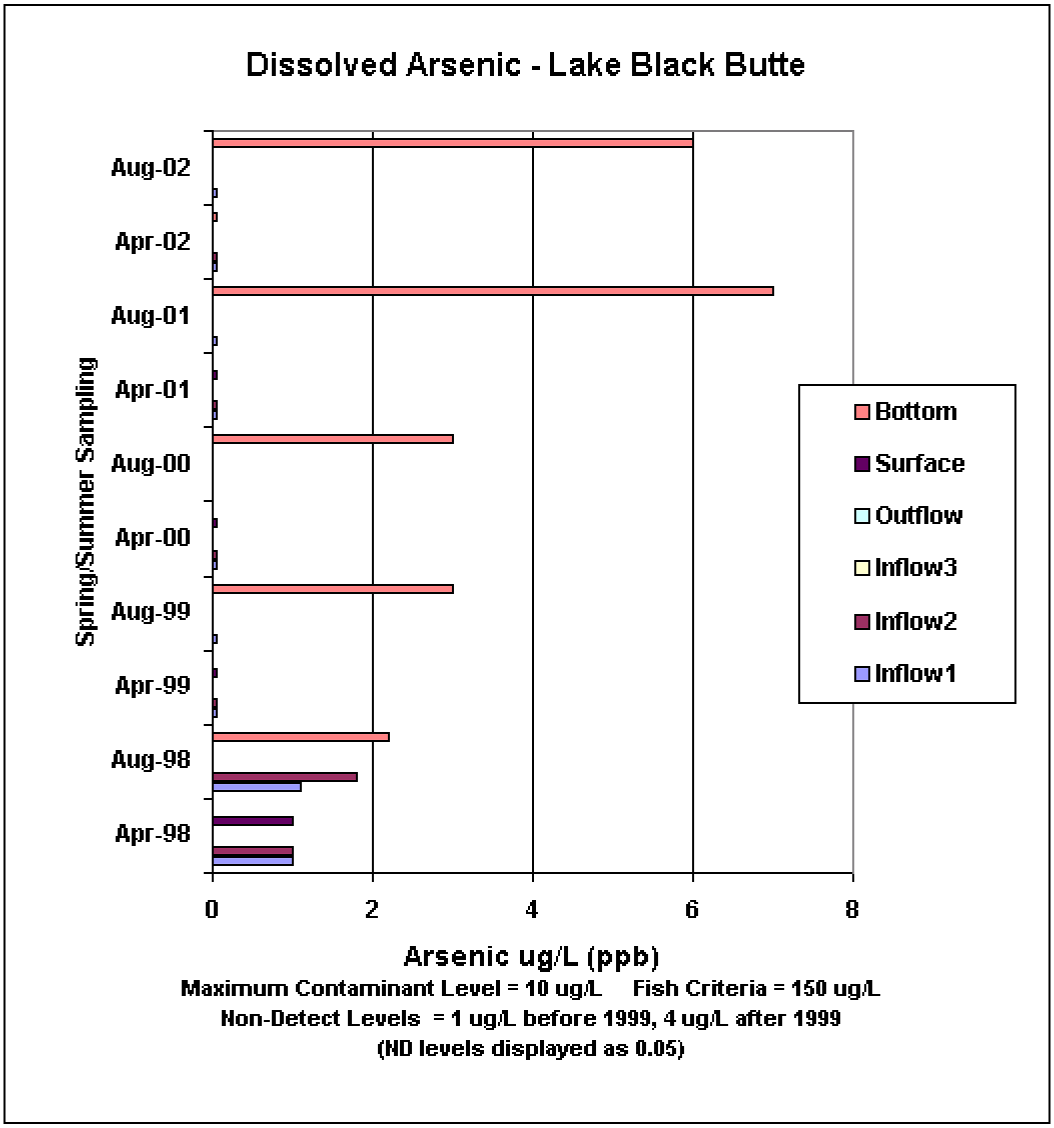
Black Butte					
Sample Location: Behind Dam				**Date:** 08/07/02	
Observers: Tim McLaughlin				**Time:** 10:45 am	
Lake Elevation: 456.76					
Weather Conditions:					
Wind Speed: 25		**Precipitation:** 0		**Temp (F):** 75	
SECCHI Depth: 3 feet and 7 inches					
Depth-M	**Depth-F**	**Temp-C**	**Cond**	**DOmg/L**	**pH**
23.7	78.7	21.58	349	0.3	7.77
22	72.2	22.34	347	0.4	7.81
20	65.6	23.04	350	0.5	7.83
18	59.1	23.30	352	0.8	7.83
16	52.5	23.72	352	1.6	7.96
14	45.9	24.09	352	2.3	8.1
12	39.4	25.19	349	4.3	8.01
10	32.8	25.42	345	4.9	8.8
8	26.2	25.56	346	5.1	8.81
6	19.7	25.57	346	5.1	8.77
4	13.1	25.60	346	5.1	8.69
2	6.6	25.43	345	5.2	8.67
0.03	1.0	25.62	346	5.2	8.66
NORTH FORK STONY CREEK (Inflow) - DRY					
Temp (F)	**pH**		**DOmg/L**	**EC**	**Flow rate (cfs)**
-	-		-	-	-
SOUTH FORK STONY CREEK (Inflow)					
Temp (F)	**pH**		**DOmg/L**	**EC**	**Flow rate (cfs)**
79.9	8.52		-	-	3
VISUAL OBSERVATIONS: Very windy. Strong hydrogen sulfide smell from bottom sample.					

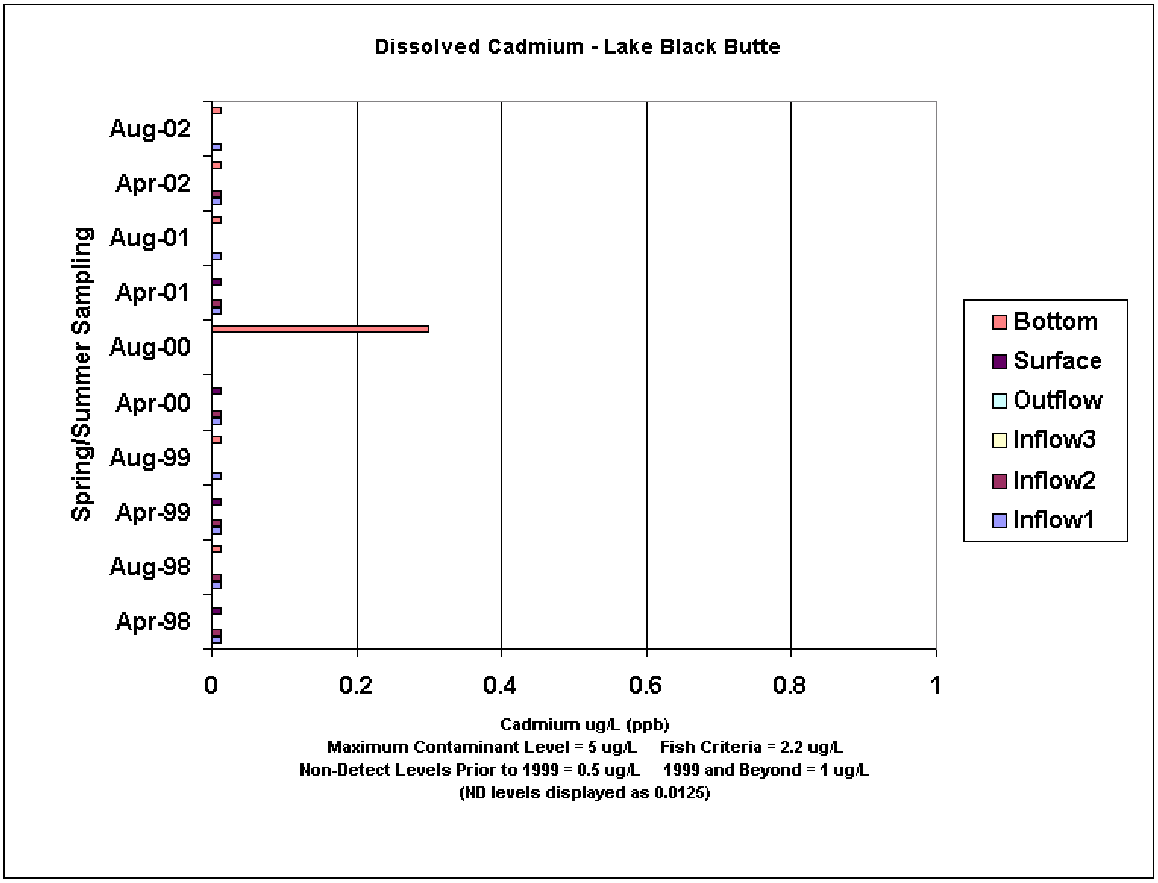
Appendix C: Phytoplankton Data and Charts

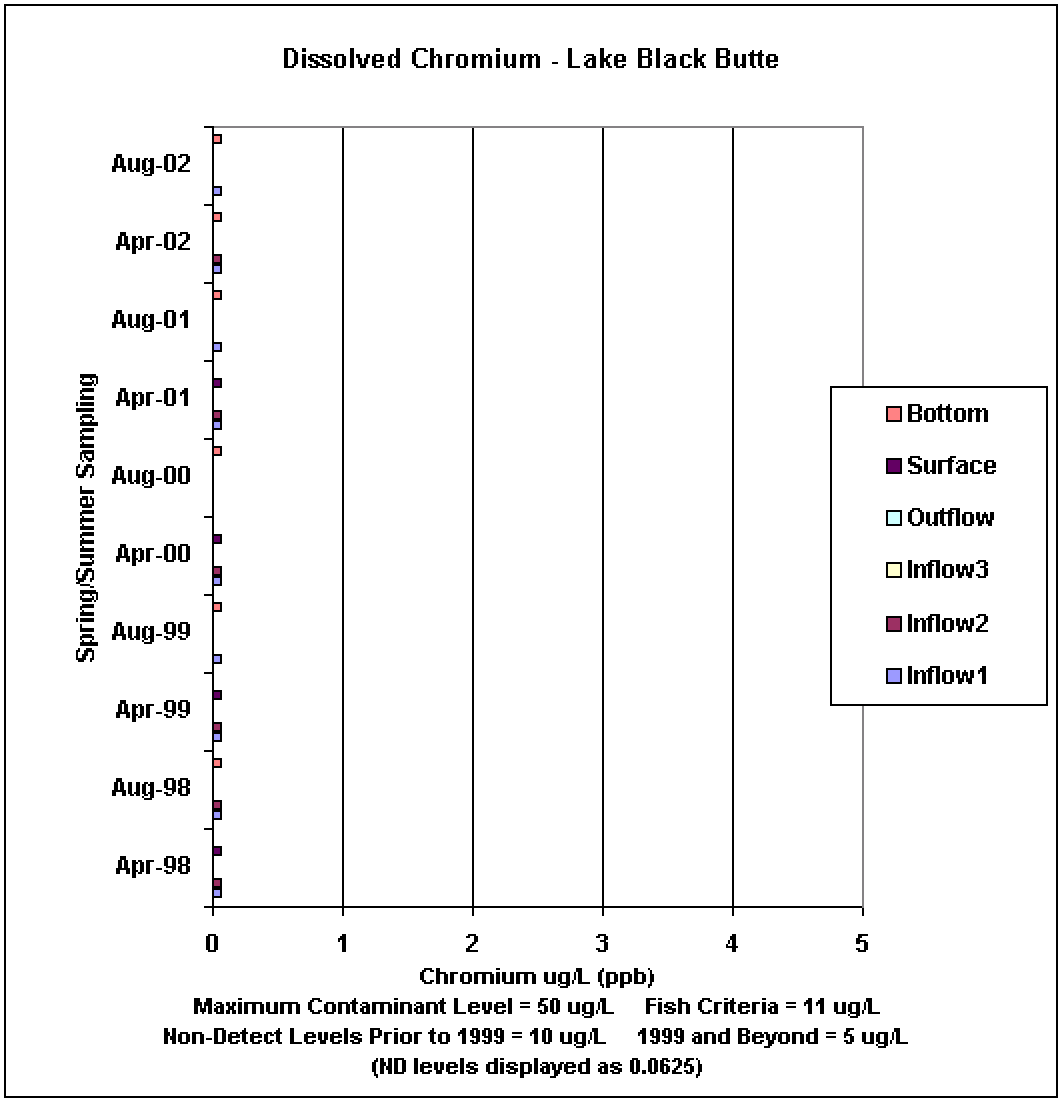


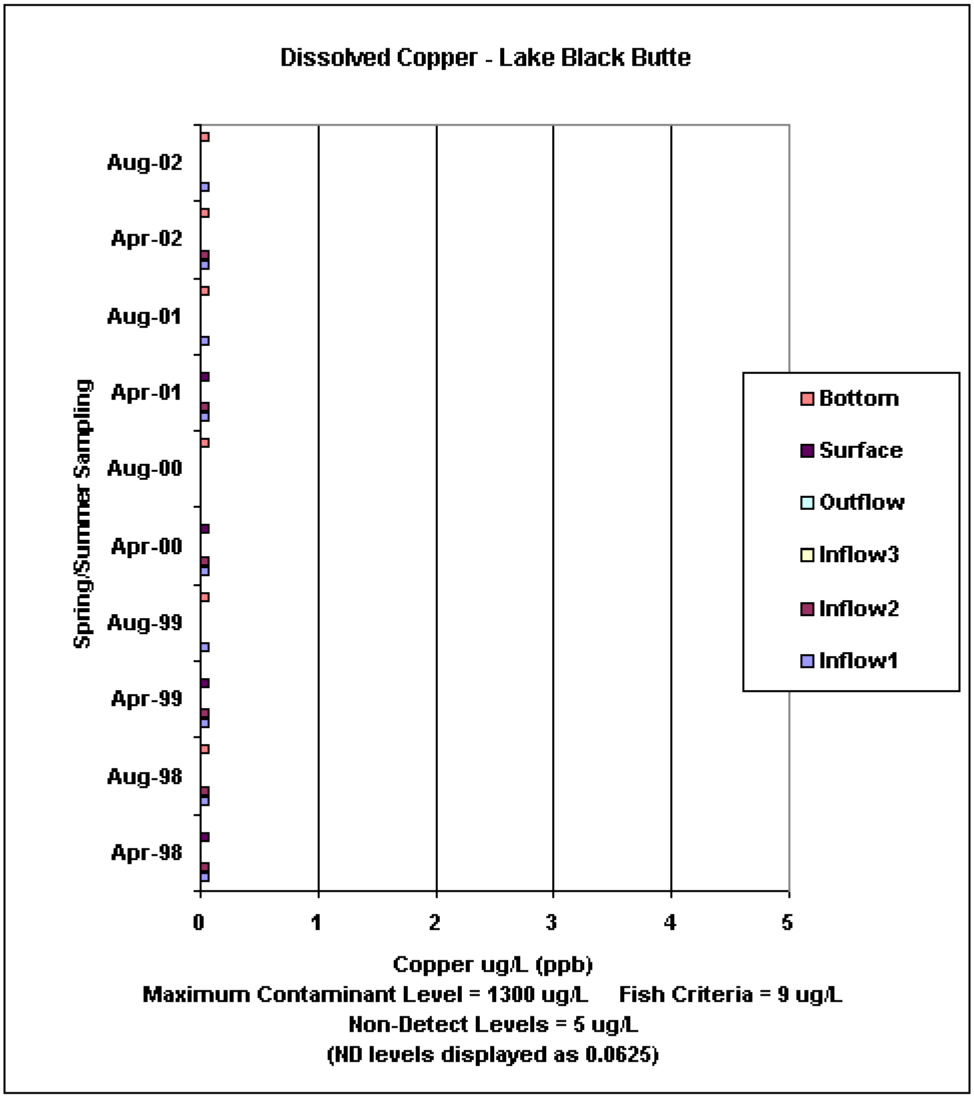
Phytoplankton Biomass 2002
Black Butte
Biomass (µg/L)
1500
1000
500
0
Euglenophytes
Bacteriophyta
Dinoflagellates
Cryptomonads
Phycomycetes
Diatoms
Chrysophytes
Greens
Bluegreens
02-Apr-02
07-Aug-02

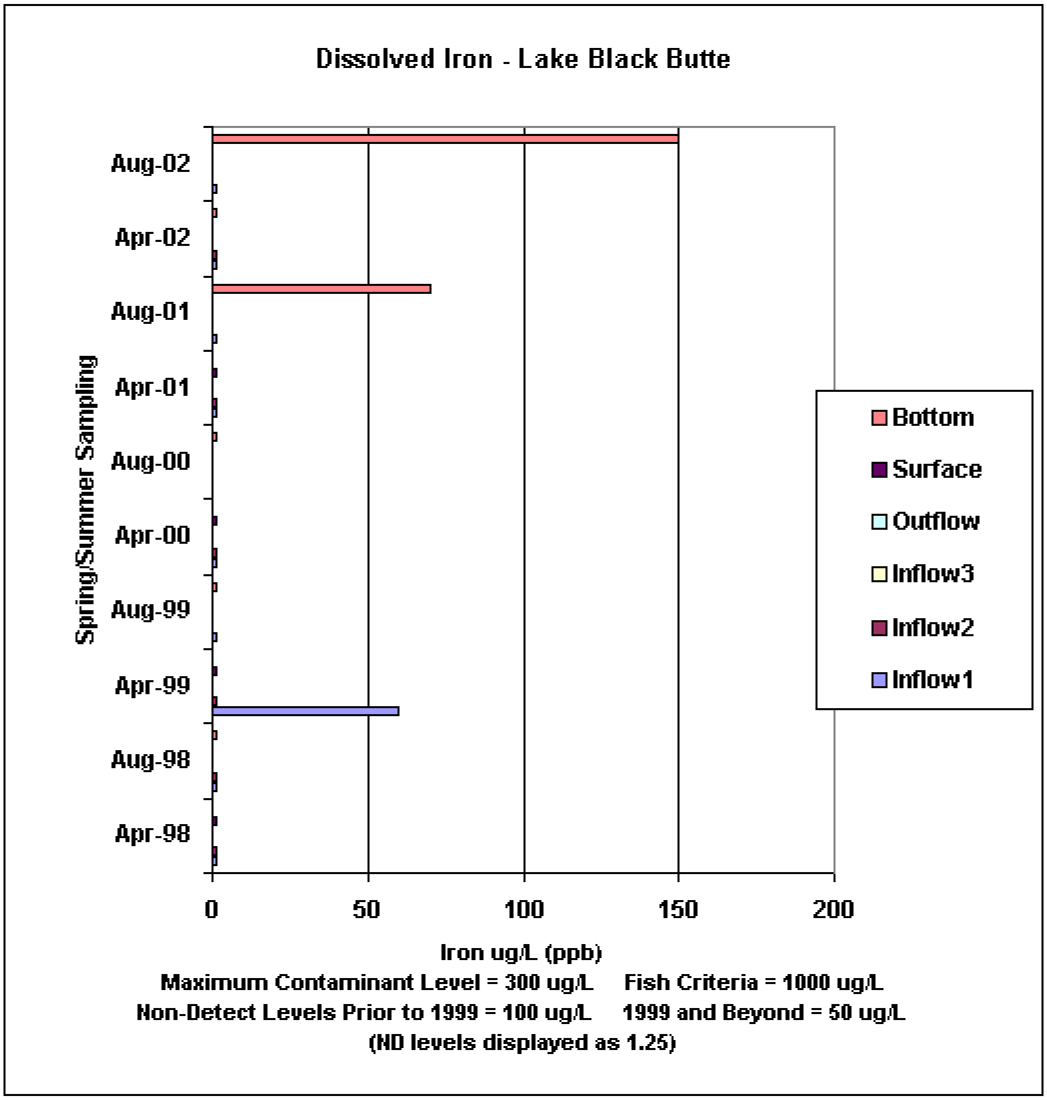
Appendix D: Metals Data and Charts

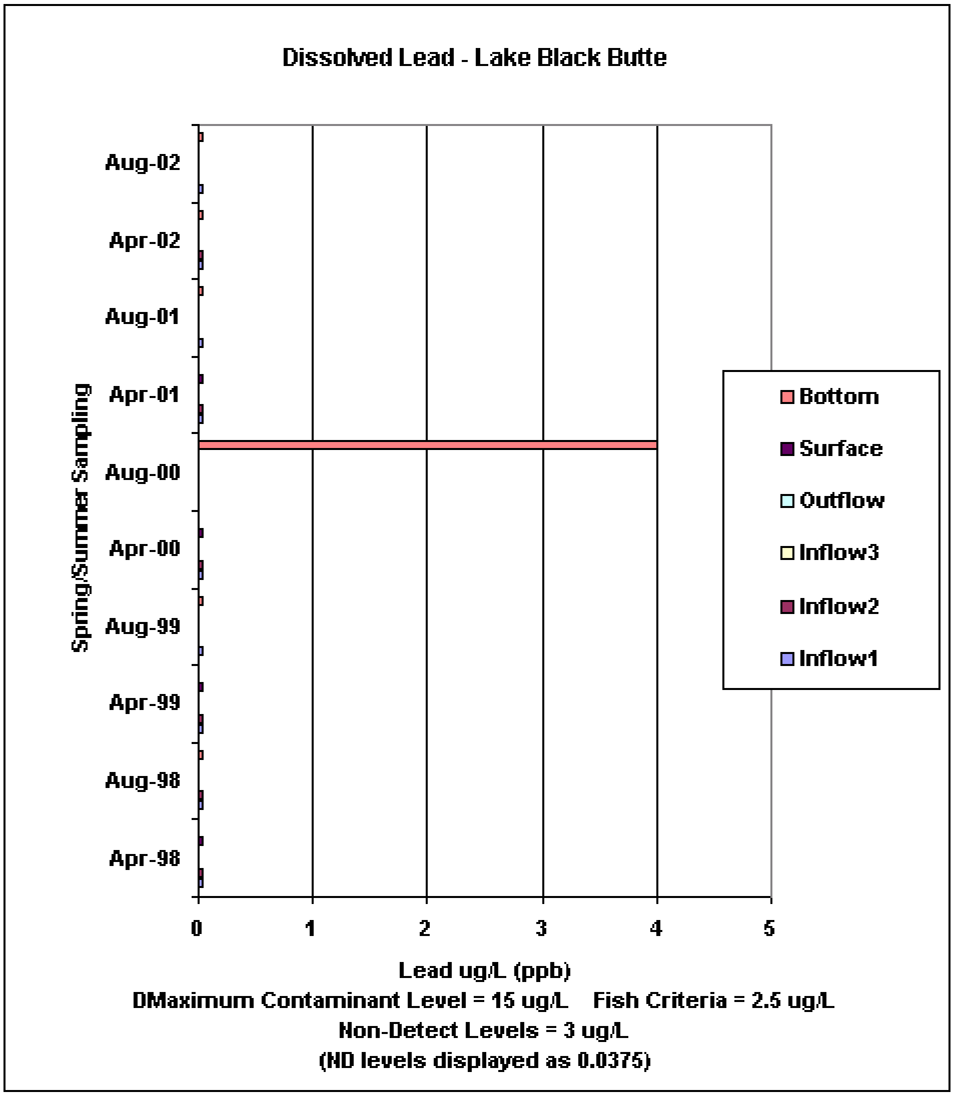

Dissolved Arsenic - Lake Black Butte
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
2
4
6
8
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Arsenic ug/L (ppb)
Maximum Contaminant Level = 10 ug/L Fish Criteria = 150 ug/L
Non-Detect Levels = 1 ug/L before 1999, 4 ug/L after 1999
(ND levels displayed as 0.05)

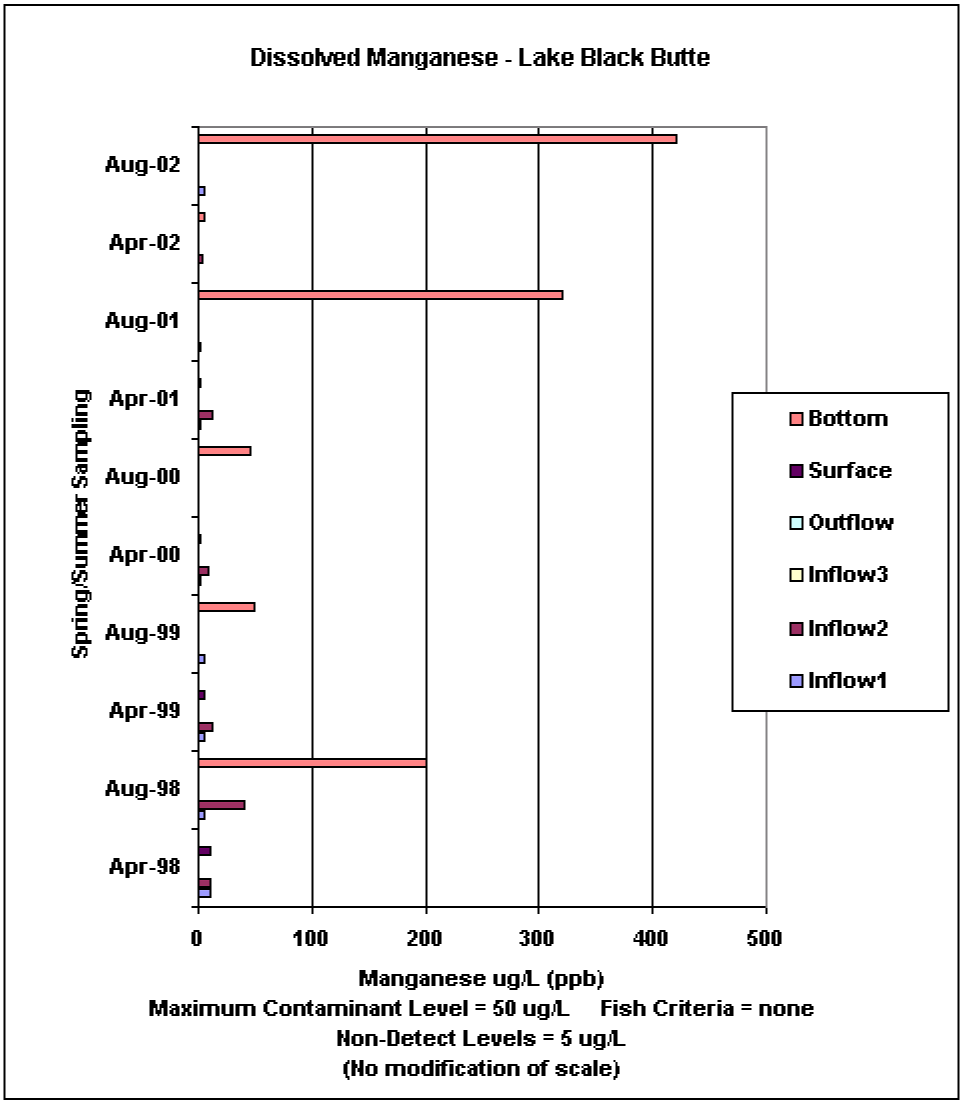

Dissolved Cadmium - Lake Black Butte
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
0.2
0.4
0.6
0.8
1
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Cadmium ug/L (ppb)
Maximum Contaminant Level = 5 ug/L Fish Criteria = 2.2 ug/L
Non-Detect Levels Prior to 1999 = 0.5 ug/L 1999 and Beyond = 1 ug/L
(ND levels displayed as 0.0125)

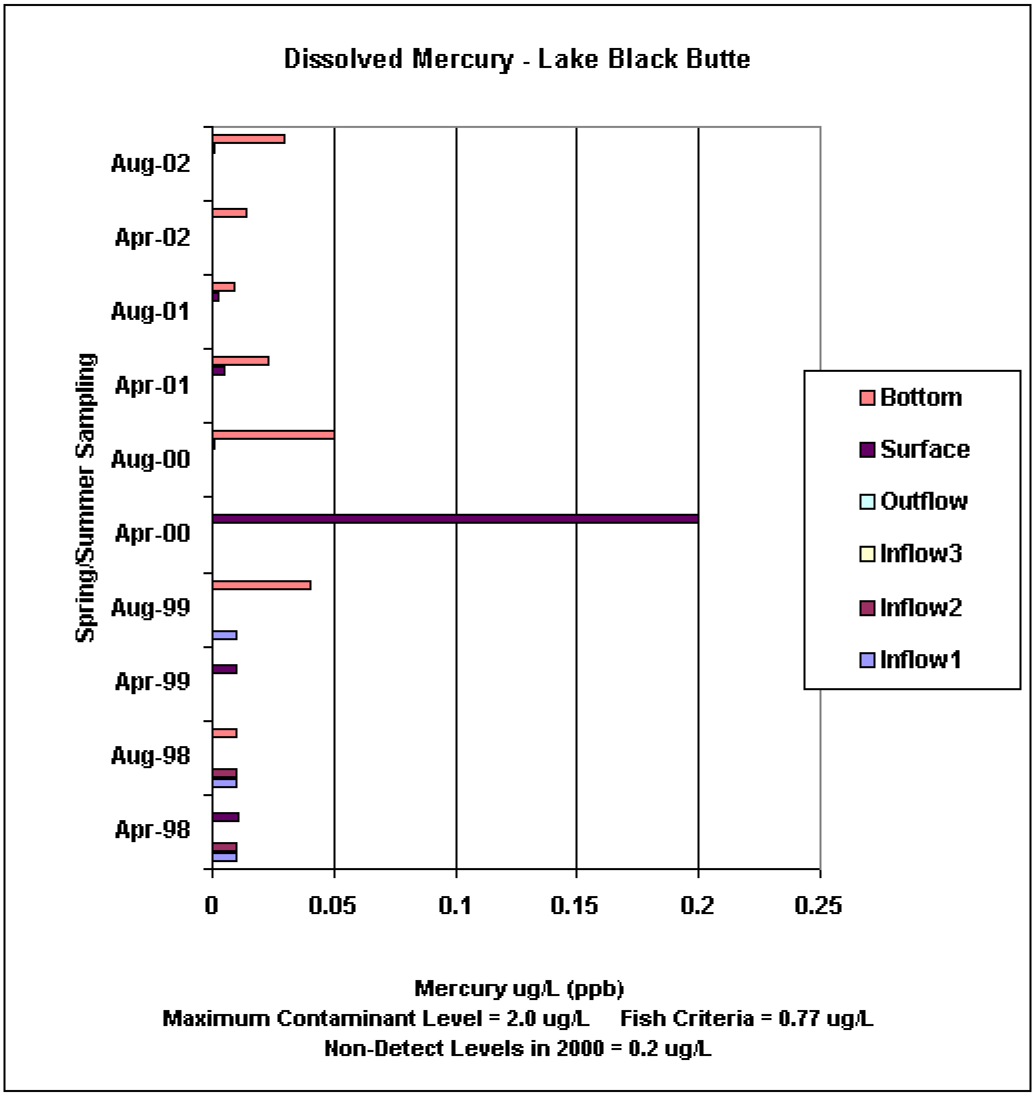

Dissolved Chromium - Lake Black Butte
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
1
2
3
4
5
Chromium ug/L (ppb)
Maximum Contaminant Level = 50 ug/L   Fish Criteria = 11 ug/L
Non-Detect Levels Prior to 1999 = 10 ug/L   1999 and Beyond = 5 ug/L
(ND levels displayed as 0.0625)
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1

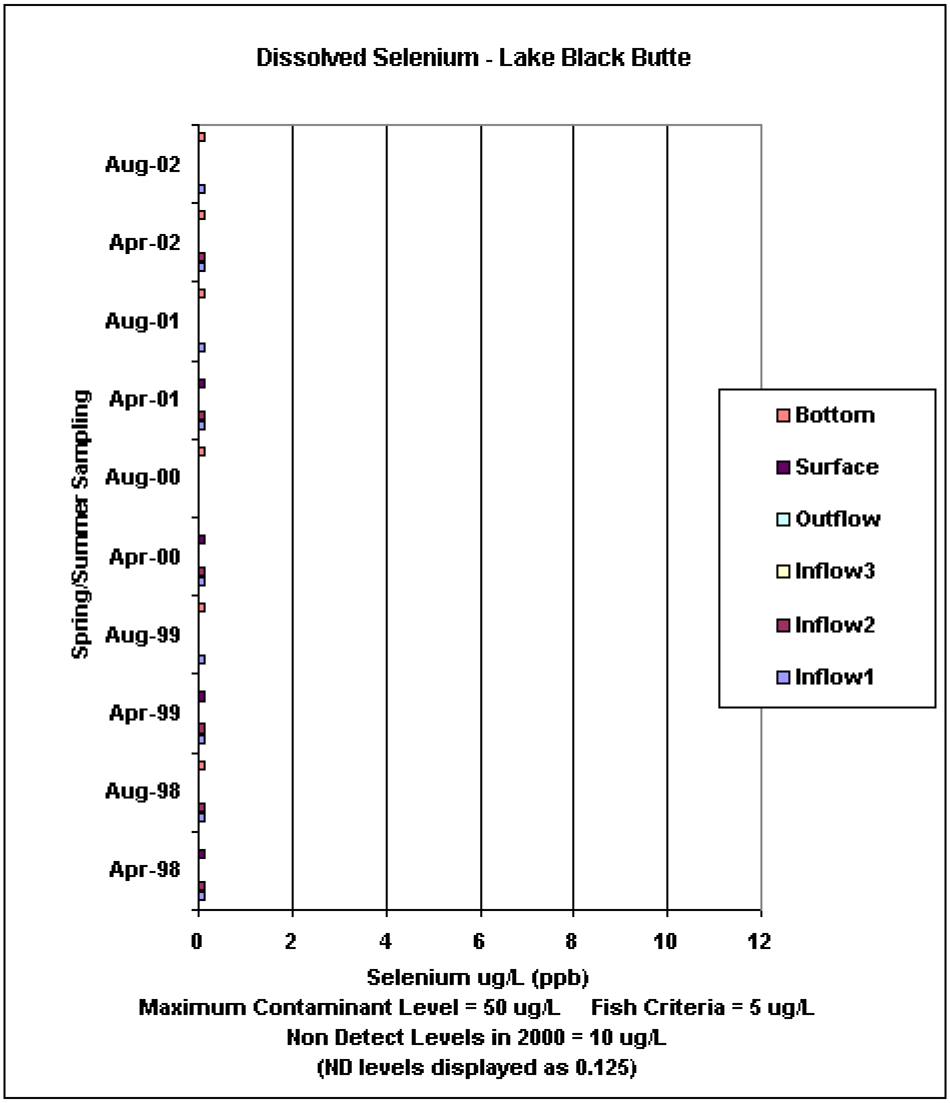

Dissolved Copper - Lake Black Butte
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
Spring/Summer Sampling
0
1
2
3
4
5
Copper ug/L (ppb)
Maximum Contaminant Level = 1300 ug/L   Fish Criteria = 9 ug/L
Non-Detect Levels = 5 ug/L
(ND levels displayed as 0.0625)
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1

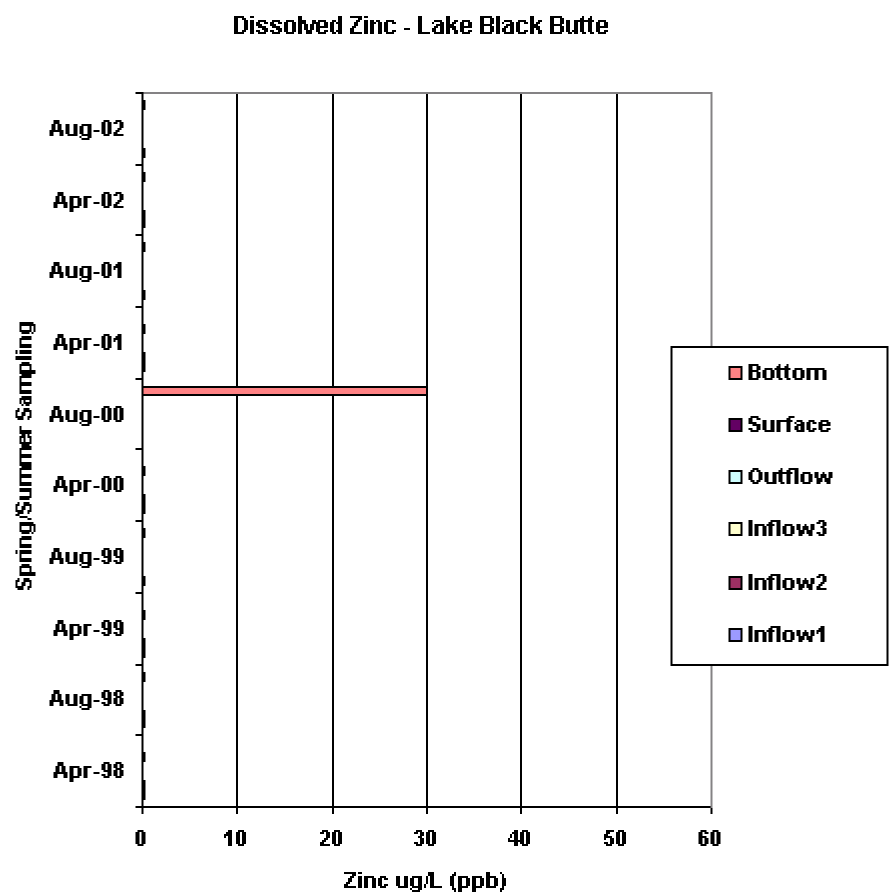

Dissolved Iron - Lake Black Butte
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
Spring/Summer Sampling
0
50
100
150
200
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Iron ug/L (ppb)
Maximum Contaminant Level = 300 ug/L
Fish Criteria = 1000 ug/L
Non-Detect Levels Prior to 1999 = 100 ug/L
1999 and Beyond = 50 ug/L
(ND levels displayed as 1.25)


Dissolved Lead - Lake Black Butte
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
1
2
3
4
5
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Lead ug/L (ppb)
DMaximum Contaminant Level = 15 ug/L   Fish Criteria = 2.5 ug/L
Non-Detect Levels = 3 ug/L
(ND levels displayed as 0.0375)


Dissolved Manganese - Lake Black Butte
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
100
200
300
400
500
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Manganese ug/L (ppb)
Maximum Contaminant Level = 50 ug/L Fish Criteria = none
Non-Detect Levels = 5 ug/L
(No modification of scale)


Dissolved Mercury - Lake Black Butte
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
0.05
0.1
0.15
0.2
0.25
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Mercury ug/L (ppb)
Maximum Contaminant Level = 2.0 ug/L
Fish Criteria = 0.77 ug/L
Non-Detect Levels in 2000 = 0.2 ug/L


Dissolved Selenium - Lake Black Butte
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
2
4
6
8
10
12
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Selenium ug/L (ppb)
Maximum Contaminant Level = 50 ug/L Fish Criteria = 5 ug/L
Non Detect Levels in 2000 = 10 ug/L
(ND levels displayed as 0.125)



Maximum Contaminant Level = 5000 ug/L Fish Criteria = 120 ug/L
Non-Detect Levels Prior to 1999 = 100 ug/L 1999 and Beyond = 20 ug/L
(ND levels displayed as 0.25)

Appendix E: Inorganic Sample Data

Inorganic Results (mg/L) For surface lake waters (spring)

	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity		60	40	50	60	30	40	70	80	20		100
Ammonia		<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Chloride		21	2	21	4	4	3	<1	6	5		4
Nitrate		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1		<0.1
Total P		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Ortho P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Sulfate		5.3	2.6	4.2	8.9	2	1	8.2	9	2.1		4.7
Kjeldahl N		0.6	0.1	0.4	0.2	<0.1	0.3	0.2	0.2	0.2		<0.1
COD					<50							
Tot Solids		120	70	100	110	60	78	100	120	21		150

Inorganic Results (mg/L) For inlet waters to the lakes (spring) (I-1 only)

	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	100	70	40	50	20	30	40	80	90	10	100	50
Ammonia	<0.1	<0.1	<0.1	<0.1	<0.1		0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chloride	13	25	3	21	<1	<1	4	<1	6	4	3	2
Nitrate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
Total P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	
Sulfate	18	2.1	2.3	3	2.8	1.9	0.8	8.8	11	1.6	11	3.5
Kjeldahl N	<0.1	0.2	<0.1	0.3	<0.1	<0.1	0.2	0.2	0.1	0.1	0.1	<0.1
COD	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Tot Solids	170	130	59	110	60	60	90	110	150	30	130	90

Inorganic Results (mg/L) For surface lake waters (summer)

	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	140	70	40	50	50	40	70	90	80	10	80	110
Ammonia	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1
Chloride	16	26	4	19	6	5	5	5	9	3	5	8
Nitrate	<0.1	1.5	<0.1	1.3	0.7	<0.1	<0.1	<0.1	<0.1	0.6	<0.1	<0.1
Total P	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sulfate	16	4.1	3.6	3.5	5.9	2	0.7	7.4	14	1.6	6.4	4.4
Kjeldahl N	<0.1	2.7	<0.1	0.4	0.4	0.3	<0.1	0.2	<0.1	<0.1	0.2	0.6
COD	<50	60	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Tot Solids	200	190	50	120	98	80	80	120	120	52	100	170

Inorganic Results (mg/L) For inlet waters to the lakes (summer) (I-1 only)

	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	150	90	40		60	40	80	100	130	20	110	180
Ammonia												
Chloride	16	490	5		10	8	3	5	14	4	5	22
Nitrate												
Total P												
Ortho P												
Sulfate	16	4.5	3		9.8	3.2	<0.5	6	14	2.7	5.4	8.7
Kjeldahl N												
COD												
Tot Solids	200	1300	50		140	100	100	150	200	50	140	280

Appendix F: MTBE Table

2002 MTBE Results
Units are ug/L (ppb)

The following table provides an overview of the lab results for the 2002 MTBE monitoring program.

Lake	Spring S	Spring S-1	Spring S-M	Spring S-C	Summer S	Summer S-1	Summer S-M	Summer S-C	Remarks
Black Butte	2		2		<2		<2		
Eastman	5				<2				
Englebright	3		3		10		10	10	
Hensley	3		3		3		3		
Isabella	<2	<2	<2	<2	<2	<2	<2	<2	
Kaweah	2		2	<2	8		6	6	
Martis Cr.	<2				<2				
Mendocino	<2				<2				
New Hogan	<2				3				
Pine Flat	<2		<2		2		2		
Sonoma		3	<2		<2		2		
Success	4		4	4	11	12	11	11	

Notes:

1. Non-Detect is indicated by "<2" since the Reporting Limit is 2 ppb or 0.002 ppm.

2. No enforceable acceptance criteria has been established for MTBE. See EPA Fact sheet.

3. Maps are provided to illustrate the sampling locations for samples: S / S-1, S-M, and S-C. Sample S and sample S1 are located near the dam; sample S-M is located within 50 ft of the Marina; and sample S-C is located near the center of the lake.

4. For 2002, the number of MTBE water sampling at each lake is based on last year's lab results.

5. 2 samples were taken from Eastman, Martis Creek, Mendocino, and New Hogan because MTBE was historically non-detectable. The 2002 results of non-detectable levels were similar except Lake Eastman and New Hogan now reported low, detectable levels of MTBE.

6. 4 samples were taken from Black Butte, Hensley, Pine Flat and Sonoma because of historically low detectable levels of MTBE.

7. 6 to 8 samples were taken from Englebright, Isabella, Kaweah and Success because of historically higher MTBE being found. The 2002 results were similar except Isabella now reported non-detectible levels.

8. In 2001, very high MTBE levels were reported at Lake Isabella during the Spring (18 ug/L near the marina) . During Spring 2000, Lake Isabella reported 21 ug/L. The 2002 results indicate that the previous MTBE problem near the marina was not visible during the Spring 2002 sampling event, and may have been rectified.

Appendix G: Fish tissue analysis table

2002 Fish Tissue Results

The following table provides an overview of the lab results for the 2002 fish tissue program. N/A indicates data is not available due to lack of fish collection. Sample Preparation, filleting and Extraction were in accordance with EPA 823-R-95-007, Sep 95, Volume 1, Section 7.2 (Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisory) which requires the following: Only the edible portion of the fillet shall be analyzed (i.e no skin, tail, fin, head). Tissue digestion shall be accomplished by adding concentrated nitric acid and heating the tube in an aluminum block to reflux the acid. The digestate shall be cooled, diluted to a final volume of 25 ml and analyzed by CVAA. The laboratory conductng the preparation and analysis was Toxscan, Inc in Watsonville, CA and the laboratory mercury analysis was in accordance with CVAA per EPA 7471. The Percent Lipids were per EPA 1664. The FDA criteria for a fish advisory is 1 ppm. The California OEHHA's action level to continue fish tissue monitoring is 0.3 ppm.

Lake	Type of Fish	Type of Analysis (number of fish)	Date collected	Percent Lipids	Mercury Total ppm	FDA Criteria
Black Butte	Sm M Bass	Composite (3)	6/12/02	0.24	0.26	1 ppm
Eastman	Note 4	--------------------	-----------	----------	-----------	< Mon 00
Englebright	Note 5	N/A	N/A	N/A	N/A	
Hensley	Black Bass	Composite (3)	4/23/02	<0.10	0.72	1 ppm
Isabella	Black Bass	Composite (3)	6/4/02	0.20	0.21	1 ppm
Kaweah	Sm M Bass	Composite (3)	7/14/02	0.11	0.53	1 ppm
Martis Cr	Note 4	--------------------	-----------	----------	-----------	< Mon 00
Mendocino	Note 6	N/A	N/A	N/A	N/A	
New Hogan	Lg M Bass	Single (1)	6/3/02	<0.10	0.34	1 ppm
Pine Flat	Note 4	--------------------	-----------	----------	-----------	< Mon 01
Sonoma	Note 6	N/A	N/A	N/A	N/A	
Success	Black Bass	Composite (3)	4/15/02	<0.10	0.18	1 ppm

Notes:

9. Non-Detect is indicated by "<0.02". The lab Detection Limit for mercury is 0.02 ppm.
10. Total Mercury was reported in mg/g or ppm.
11. Total Mercury was conducted instead of Methyl Mercury since EPA 832 allows Total Mercury analysis for an initial screening program. When specific problem areas are identified, methyl mercury analysis are normally performed later as part of the actual health risk assessment.
12. The fish tissue program was terminated at Eastman and Martis Creek in 2001 and in Pine Flat in 2002 due to low total mercury results. In 2000, the total mercury was only 0.089 ppm for Eastman (Catfish) and the total mercury was <0.02 ppm for Martis Creek (Brown Trout). For Pine Flat total mercury was 0.21 ppm in 2000 (composite of three Sacramento Sucker fish) and 0.23 in 2001 (composite of three spotted bass).
13. Due to seasonal conditions, a fish could not be successfully collected at Lake Englebright. Another attempt will be accomplished for the 2003 report.

14. Fish were not collected at Mendocino or Sonoma due to communication difficulties.

The above 2002 total mercury results indicate only Hensley is higher than average. However, in 2001, the total mercury results were only 0.30 ppm for Hensley (small mouth bass). The 2003 fish tissue program should provide additional data. EPA fact sheet on fish advisories (EPA-823-F-99-016) indicates that the mean average mercury results from numerous lakes in the Northeast United States were found to be 0.46-0.51 ppm for largemouth bass and 0.34-0.53 for smallmouth bass.